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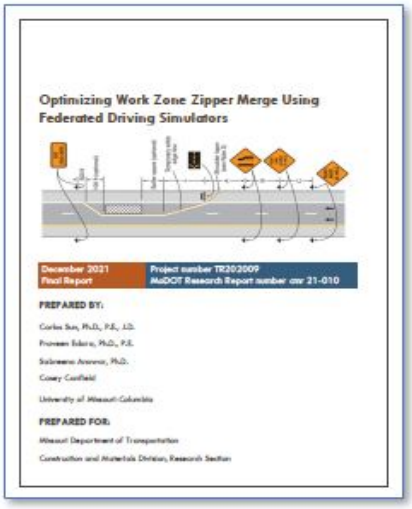
# Research Summary

## Optimizing Work Zone Zipper Merge Using Federated Driving Simulators




Departments of transportation (DOTs) are finding that early merge at work zone lane closures could have several drawbacks, one being wasted capacity of the closed lane, leading to longer queues in the open lane(s) that could potentially extend beyond work zone signage. Another issue is queue jumping behavior, described as some vehicles zooming past the queue and trying to cut in at the last minute. Such drawbacks could result in various problems. In response, several DOTs have begun to use the late merge or zipper merge system. Zipper merge has the potential to utilize wasted closed lane capacity, reduce congestion and queuing, and bring about uniformity at the merge point. This research project is an effort to help refine zipper merge deployment by reviewing existing literature, conducting a simulator experiment, surveying human subjects, and analyzing educational materials.

A major task of this project was a driving simulator study using human subjects. There are several advantages of using the simulator approach for studying zipper merge. One major advantage is the difficulty of obtaining heavily congested data over long periods of time in the field. Another advantage is the ability to easily examine various factors since the virtual world could easily be changed to isolate the effects of a specific factor. This flexibility is lacking from field studies where real-world conditions are often uncontrollable. An advantage related to safety is that human subjects are exposed to minimal risk in a simulator experiment.

One main finding of this project is that public education is vital to public compliance and the proper functioning of zipper merge. Of the 50 subjects that were surveyed, over 60% were not familiar with zipper merge. A survey question about zipper merge signage showed that there is significant potential for drivers to misinterpret the zipper merge sign package.

*"Several DOTs have begun to use the late merge or zipper merge system."*

Another finding involving public education was that effective public education does not have to be elaborate or lengthy. With both the simulator and the survey, a short, concise message explaining zipper merge was presented to human subjects. Such a short message was effective to generate proper understanding and behavior from subjects.

The challenge with education appears to be one of reaching the vast driver population in Missouri and using education to counter the ingrained habit of merging early. The existing educational materials from several DOTs were examined. Appeals to reason and emotion were

especially popular. In terms of content there was not a single video or news release that was superior to others. Based on survey results and social behavioral science, a recommendation is offered to chunk (i.e., group information into smaller, easily digestible sections) the current MoDOT zipper merge web page. The goal of chunking is to present information in a way so that a person can quickly identify and process the main points related to zipper merge.

The literature, simulator, and survey offered slightly different recommendations in terms of the traffic speed at which the zipper merge could be effective. The literature and the survey results both suggest that lower speeds were preferred. In the simulator experiment there was not a significant difference between background traffic traveling at 55 mph and 40 mph. The small difference in distances, 68.8 feet at first blinker use and 64.2 feet at merge, were not statistically significant. The practical conclusion is that zipper merge could work well even at higher speeds even though the preference is for lower speeds. The literature, simulator, and survey also offered slightly different recommendations in terms of the traffic flow at which the zipper merge could be effective.

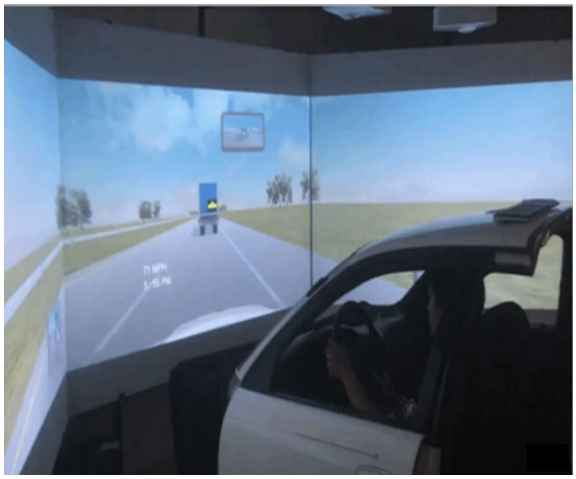


**Figure 1: ZouSim driving simulator**

## *Project Information*

**PROJECT NAME:** TR202009—Optimizing Work Zone Zipper Merge Operations Using Driving Simulations

**PROJECT START/END DATE:** November 2019-September 2021

**PROJECT COST:** $130,000

**LEAD CONTRACTOR:** University of Missouri-Columbia

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